We thank the reviewer for their positive assessment of our manuscript. We appreciate the reviewer's acknowledgement of the connection with the recent global study by Barceló-Llull et al. (2025) and their appreciation of the added value provided by our regional focus on the Mediterranean Sea.

Below, we provide a detailed point-by-point response to each of the reviewer's comments, along with a summary of the corresponding modifications implemented in the revised manuscript.

General Comment

The manuscript assesses trend in EKE in the Mediterranean Sea over the 1993-2023 using gridded altimetry products (a two-satellite product and two all-satellite products). The authors examine both basin-wide and regional EKE changes, analyse differences between products, investigate eddy characteristics, validate trends against along-track data and explore the influence of sampling changes associated with the increasing number of altimeters.
The manuscript is clearly written and the results are clearly presented supported by thoughtful figures.
This work follows closely the recent global study by Barceló-Lull et al. (2025). The present manuscript applies a very similar methodological framework - contrasting two satellite and all-satellite altimetric products and analysing regional EKE trends — but within the specific context of the Mediterranean Sea. In doing so, it provides a valuable regional application that complement the global perspective.
I recommend its publication with minor revisions.

Barceló-Llull, B., Rosselló, P., Combes, V., Sánchez-Román, A., Pujol, M. I., and Pascual, A.: Kuroshio Extension and Gulf Stream dominate the Eddy Kinetic Energy intensification observed in the global ocean, Sci. Rep-UK, 15, https://doi.org/10.1038/s41598-025-06149-9,2025.

Specific Comments

Line 92: For clarity and consistency with common altimetry literature, the authors may consider referring to this component as the cross-track velocity.
We agreed and changed "orthogonal" for "cross-track".

Lines 140-143: The study reports trends for the eastern Alboran gyre but no figure specifically highlights this sub-region. Including a small inset or zoomed panel for the eastern gyre would help readers better visualise these local trends.
We added the trends for the eastern Alboran gyre as a subplot of Fig. 3 (Fig. 3c).

Figure 3: Please defined "area-weighted mean". A brief explanation of how the weighting is performed would improve clarity.
We added a definition of "area-weighted mean" in section 2.2.1.

Figure 4: I suggest slightly rephrasing the caption for panel (a) for clarity. For example: "Time series of the difference between all-sat-glo and two-sat-glo EKE and the number of altimetry missions."
We agree and corrected it.

Lines 186-188: "Even though, the norther nIonian Sea … from anticyclonic to cyclonic." The sentence is not very clear. I suggest the following rephrasing:
"The northern Ionian Sea also shows negative trends, whereas the central Ionian displays positive trends, a pattern that may be linked to shifts in the basin's circulation between anticyclonic and cyclonic states (Bessières et al., 2013; Kalimeris and Kassis, 2020)."
We included this change as it makes the text clearer (L. 204-207).

Table 1: The terms "mean of all trends" and "trend of the mean" should be defined.
We have clarified these definitions.
The manuscript now includes the following text (L. 212-214): **"Mean of all trends" corresponds to the spatial average of all grid-point trends. "Trend of the mean" represents the linear trend computed from the basin-wide area-weighted EKE time series, the one shown in Fig. 3.**

Line 193: As mentioned in a previous comment, the term "area-weighted mean" has not been defined and should be clarified.
Added in section 2.2.1.

Line 200: The motivation for recomputing EKE using the CMEMS 1993–2012 reference period is not fully explained. It is a bit unclear to me what additional insight it provides beyond showing the sensitivity of trends to anomaly definition. The need to compute geostrophic anomalies with respect to the full time period is standard practice.
We recomputed anomalies over the period 1993–2023 to ensure that the temporal mean of the anomaly is zero. We added the analyses on the CMEMS provided data (reference period 1993-2012) to evaluate a possible change in the magnitude of the trends. We have noticed that a large number of studies compute EKE using the anomalies directly provided by CMEMS, which are based on a non-centered reference period (1993–2012) (L. 95-98).

Figure 7(b): We observe a negative trend in the L3-ref date that does not appear in the L4 product. Could the authors provide an explanation for this discrepancy?
If the reviewer refers to the beginning of track 96 in Fig. 7b (first five points), the discrepancy may be related to the proximity of the satellite measurements to the coast, a region where altimetric data generally have increased uncertainties.
If the reviewer refers to the middle of the track (around point 15), the L3 product represents single-track, pointwise measurements without spatial averaging. As a result, the EKE at this location is highly sensitive to small shifts in the gyre position or structure. In contrast, the L4 fields involve spatial interpolation and smoothing, which tend to attenuate very localized variability. This difference in the product could explain the small difference in the trends obtained there.

Line 211: I would suggest using the term "cross-track" instead of "perpendicular".
We modified it.

Section 3.4: The manuscript reports statistics for "mesoscale eddies" in general, without distinguishing cyclonic vs anticyclonic. EKE contributions and dynamical behaviour can differ between cyclones and anticyclones. The authors could provide separate statistics if possible. Even a brief note would strengthen the interpretation.

We agree with the reviewer and separated cyclones from anticyclones in our analysis and modified Fig. 8 and the results description in section 3.4 (L. 249-269):

In this section, we focus on the statistics of these mesoscale eddies derived from the all-sat-glo and two-sat-glo satellite products, distinguishing cyclonic from anticyclonic eddies, including their number, size, spatial extent, and rotational speed (Fig. 8). A representative snapshot of detected eddies from each dataset on January 4, 2020, illustrates clear differences with the all-sat-glo product capturing a larger number of eddies and finer-scale structures compared to two-sat-glo (Fig. 8a).

Over the altimetric era, the number of eddies detected per year shows a stronger increasing trend in all-sat-glo (27812 per year on average) than in two-sat-glo (23744 per year, Fig. 8b). For both products, a higher number of cyclones than anticyclones is detected with 57% of the eddies being cyclonic, in agreement with Pegliasco et al., 2021. In parallel, the decreasing trend in the eddy radius size in the all-sat-glo product for both cyclonic and anticyclonic structures (Fig. 8c) reflects its improved ability to detect smaller-scale features (Amores et al., 2018). In contrast, in the two-sat-glo product only anticyclones show a decrease in radius, while cyclones do not display any detectable trend (Fig. 8c).

Despite these negative trends for the mean radius, when eddies are not separated by polarity, the total eddy area remains approximately constant and similar between the two products. However, separating cyclones from anticyclones reveals opposite tendencies in the two-sat-glo product (Fig. 8d): the total area covered by anticyclones decreases, while the area associated with cyclones increases. No marked polarity-dependent trends are observed in the all-sat product.

Finally, the average eddy rotational velocity (Fig. 8e), highly relevant to local biogeochemical variability, shows significant increasing trends in the all-sat-glo data, with a stronger increase for anticyclones, while no such trend is evident in two-sat.

In general, these results indicate that the progressive increase in the number of altimetric satellites has enhanced the detection of mesoscale activity (Amores et al., 2018), leading to more numerous, smaller, and faster eddies in the all-sat-glo product, while the total eddy-covered area remains unchanged. These discrepancies also mirror the EKE results and further highlights the limitations of the two-satellite configuration in resolving the diversity of mesoscale processes in the Mediterranean Sea, consistent with earlier work by Pascual et al., 2007.

We also deepen our discussion in section 4.2 (L. 328-354):

Eddy characteristics shown in Fig. 8 have also highlighted this artificial trend: the number of detected eddies increases with time for all-sat-glo, whereas the total area they occupy remains approximately constant. This suggests that the enhanced

temporal and spatial sampling of all-sat products, arising from the growing number of satellites, enables the detection of smaller eddies that were previously unresolved.

Moreover, the distinction between cyclonic and anticyclonic eddies reveals several polarity-dependent differences in the long-term evolution of eddy statistics (Fig. 8), pointing out intrinsic differences in their detectability and dynamical behavior. Overall, more cyclones are detected (57 % Fig. 8 and Pegliasco et al., 2021). This asymmetry is fully consistent with the known differences in the reliability of eddy detection in gridded altimetric products.

In fact, Stegner et al., 2021 have shown that anticyclones in the Mediterranean are detected with high positional accuracy and moderate radius biases, while cyclones, particularly large ones, are substantially less reliable, with larger position errors, stronger overestimation of radius (only category without negative trend in Fig. 8c), and greater sensitivity to interpolation artifacts. These detection biases arise from fundamental dynamical differences: large anticyclones tend to be more coherent and longer-lived, whereas cyclones are more unstable and prone to splitting into smaller, fast-evolving sub-mesoscale structures that are poorly resolved by altimetric gridding.

The two-sat product, which maintains a stable configuration over time, further supports this interpretation. While it shows no significant trends in eddy number or speed, separating polarities reveals positive trend in cyclones total eddy area. This pattern is consistent with the "coarsening artifact" described in Stegner et al., 2021, where small structures are smoothed into larger, spurious cyclonic features during interpolation.

These polarity-dependent behaviors have direct implications for the interpretation of EKE trends in gridded altimetric products. The stronger increase in mean rotational speed for anticyclones than for cyclones in all-sat suggests that the positive EKE trends reported in multi-mission products are driven by anticyclonic intensification, as observed in the semi-permanent Alboran gyres.

As a result, long-term EKE trends in all-sat configurations should be interpreted with caution, as they may reflect improved sampling of anticyclones rather than energetic changes in the mesoscale field. Nonetheless, part of the differences in EKE trends can also be attributed to the two-sat product being derived from a two-satellite constellation and, as demonstrated by Pascual et al., 2007, a minimum of three concurrent altimeter missions are required to adequately monitor mesoscale variability in the Mediterranean Sea.

We hope these revisions adequately address the reviewer's concerns and improve the clarity and scientific contribution of our manuscript. We remain grateful for the helpful feedback.

Sincerely,

Paul Hargous, on behalf of all co-authors